



First records of the whirligig beetles *Gyretes minax* Ochs, 1967 and *G. puberulus* Ochs, 1967 (Coleoptera, Gyrinidae) from Maranhão state, northeastern Brazil

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Abstract

The genus *Gyretes* Brullé, 1835 has 181 species occurring in Brazil, most of them known in the country's North Region. In this study, we record for the first time the occurrence of *Gyretes minax* Ochs, 1967 and *Gyretes puberulus* Ochs, 1967 in Maranhão state, northeastern Brazil. We also provide a diagnosis and illustrations for each of these species and comment on their geographical distributions.

Keywords

Aquatic beetles; Gyrininae; new records; Northeast Brazil.

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Introduction

The Gyrinidae, or whirligig beetles, are readily recognized for their unique swimming behavior, where adults rapidly swim on the surface of water (Brinck 1955). Whirligig beetles occur throughout the world, with representatives in all major zoogeographical regions except Antarctica. This family includes about 900 described species in three subfamilies: Spanglerogyrinae, Heterogyrinae, and Gyrininae (Miller and Bergsten 2012). The last subfamily is divided into three tribes: Gyrinini, Dineutini, and Orectochilini (Gustafson and Miller 2013).

Gyretes Brullé, 1835 is included in the tribe Orectochilini and has more than 300 species distributed from eastern and southern North America to South America,

where it occurs throughout lowland regions (Miller and Bergsten 2012). It is characterized by having antennae with nine-segmented flagellae and the scutellum concealed with the elytra closed in both sexes (Miller and Bergsten 2012). Members of this genus are common in aquatic habitats, including lakes, ponds, rivers and streams; most species prefer running water (Benetti and Fiorentin 2003; Babin and Alarie 2004). Adults can be observed in shaded areas of water bodies and on emergent macrophytes, and they frequently leave the water to rest on emergent roots and leaves (Folkerts and Donavan 1973).

Existing studies for *Gyretes* species are old and uninformative, most of them consisting only of brief descriptions. So far, the genus as a whole has not been revised, but some regional revisions have been made, including

Ochs (1949) for Central America, Ochs (1954) for Peru and the Andean region, Ochs (1956, 1959) for Uruguay, Ochs (1953, 1980) for Venezuela, Ochs (1963, 1964) for Guianas, Ochs (1966) for southern and southeastern Brazil, and recently Babin and Alarie (2004) for the United States.

In a recent checklist of the whirligig beetles from Brazil, Colpani et al. (2014) reported 181 species and subspecies of *Gyretes*, with most of these species known in the North Region. However, the diversity of *Gyretes* in the Northeast Region is still poorly known, with only the states of Bahia and Pernambuco having species recorded. Here, we provide the first records of *G. minax* Ochs, 1967 and *G. puberulus* Ochs, 1967 for Maranhão state, in northeastern Brazil. In addition, we present a diagnosis, illustrations, and a distribution map for each species.

Methods

Specimens of *Gyretes* were collected in 2014 using a D-frame aquatic net in stream water habitats in the Área de Proteção Ambiental do Inhamum (APA Inhamum), which is located in the municipality of Caxias, Maranhão state, northeastern Brazil. The vegetation in this region is composed of small trees and grass in flat areas, while in depressions there are large trees associated with aquatic environments (Fernandes et al. 2007). Adults were identified based on the original descriptions (Ochs 1967; Laboulbène 1853) and compared with type material deposited at the Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt, Germany (SMF) and Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA).

To observe the aedeagus, this structure was dissected and cleared using hot 85% lactic acid for 30 minutes and then rinsed in distilled water. After clearing, it was stored in 80% ethanol in a plastic microvial together with the remainder of the specimen.

Photographs of adults were obtained with a Leica DFC 420 video camera attached to a Leica M165C stereomicroscope using a LED illumination dome (Kawada and Buffington 2016). Stacks of images of each structure were produced at different focal distances; these were then combined automatically into a single image with a greater depth of field using Helicon Focus® (version 6.7.1 Pro) stacking software. Photographs were assembled into plates using Adobe Photoshop®.

The maps showing the distribution of the species treated here were created using QGIS 2.18.10. Previous records of the species were taken from the literature, and for those without geographical coordinates we used Google Earth to locate the approximate collection site. In the results for geographical distribution, asterisks represent new records. Morphological terminology used in this study follows Gustafson and Short (2017). All examined specimens are deposited in the Coleção Zoológica do Maranhão, Caxias, Maranhão, Brazil (CZMA).

Results

Gyretes minax Ochs, 1967

Figures 1–8

Gyretes minax Ochs 1967: 149. Type locality: Serra do Roncador, Nova Xavantina, Mato Grosso, Brazil. Ratcliffe and Penny 1978: 693 (type list); Rafael et al. 1983: 920 (type list); Adis et al. 1985: 493 (type list); Benetti and Hamada 2003: 704, 707 (record); Colpani et al. 2014: 200 (checklist); Colpani et al. 2018: 355 (eggs).

Diagnosis. *Adult male*: dorsal surface dark brown, shiny, dark yellow crease on pronotum and elytra (Figs 1, 2); ventral surface orange-brown, fore legs and epipleura light brown, median and posterior legs orange-brown (Fig. 3); dorsal eyes triangular (Fig. 4); labrum with golden yellow setae on apical edge (Figs 4, 5); pronotal pubescent border narrowed, wider at the base with 3 or 4 rows of setae (Figs 1, 5); elytra with fine punctures, pubescent border very narrow; elytral apex slightly pubescent with sparse setae (Figs 1, 6); elytral apex with outer angle truncated obliquely and inner angle rounded (Fig. 6); protarsus $2.0 \times$ longer than wide (Fig. 3). *Aedeagus*: parameres slender, with apex rounded and with a row of short setae on each latero-apical edge, starting on apical $1/3$; median lobe with apex rounded (Fig. 7).

Geographical distribution (Fig. 8). BRAZIL (Amazonas, Maranhão*, Mato Grosso, Pará) (Colpani et al. 2014).

Material examined. BRAZIL • 5 ♂; Maranhão/Caxias/ APA Inhamum/Igarapé Soledade; $04^{\circ}53'40.8''S$, $043^{\circ}25'18.9''W$; 384 m a.s.l.; 20–21 Dec. 2014; G.R. Desidério & S.R.S. Nascimento leg.; water surface; CZMA.

Gyretes puberulus Ochs, 1967

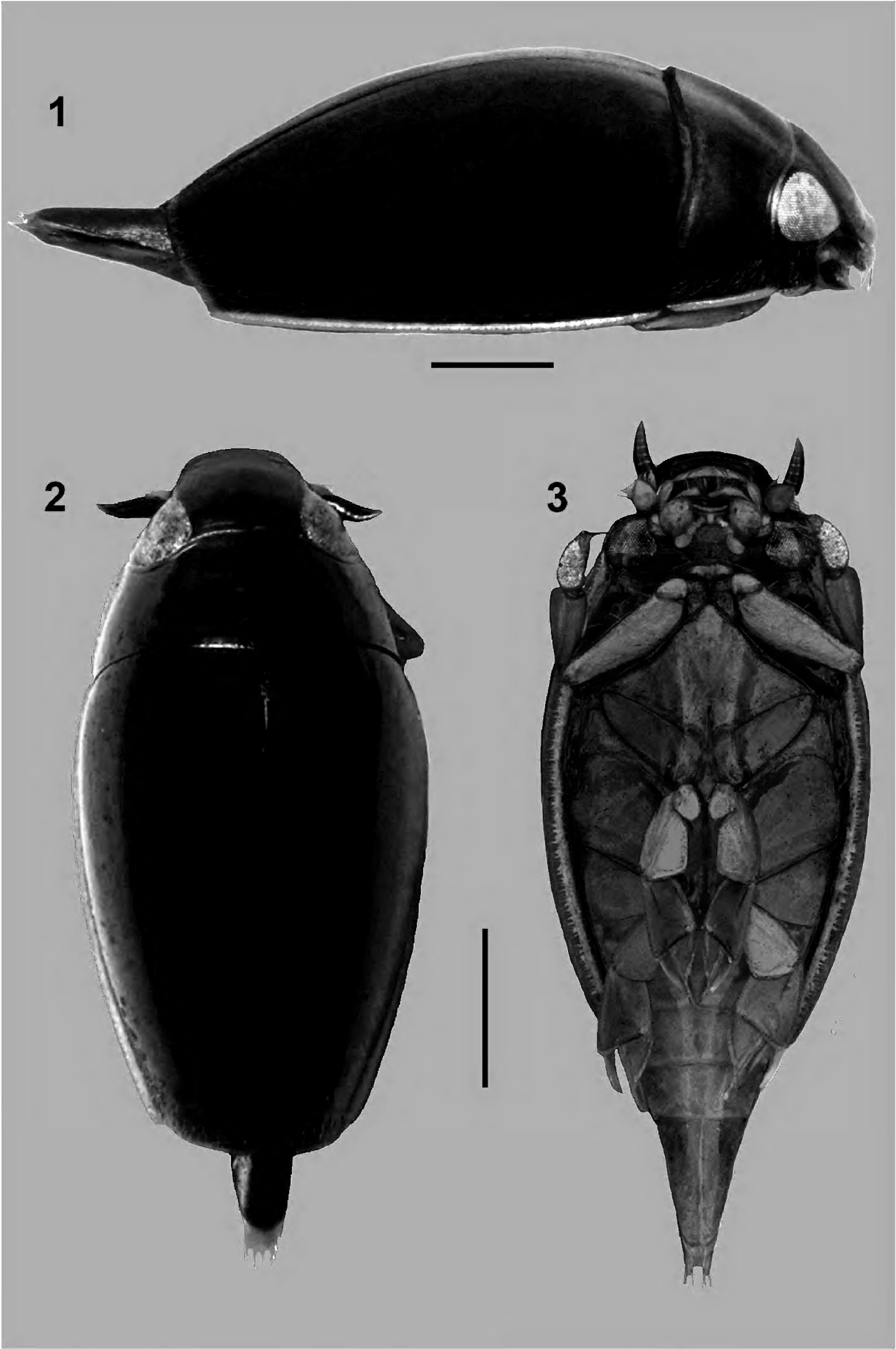
Figures 9–16

Gyretes puberulus Ochs 1967: 154. Type locality: Serra do Roncador, Nova Xavantina, Mato Grosso, Brazil. Ratcliffe and Penny 1978: 693 (type list); Rafael et al. 1983: 920 (type list); Adis et al. 1985: 493 (type list); Colpani et al. 2014: 203 (checklist).

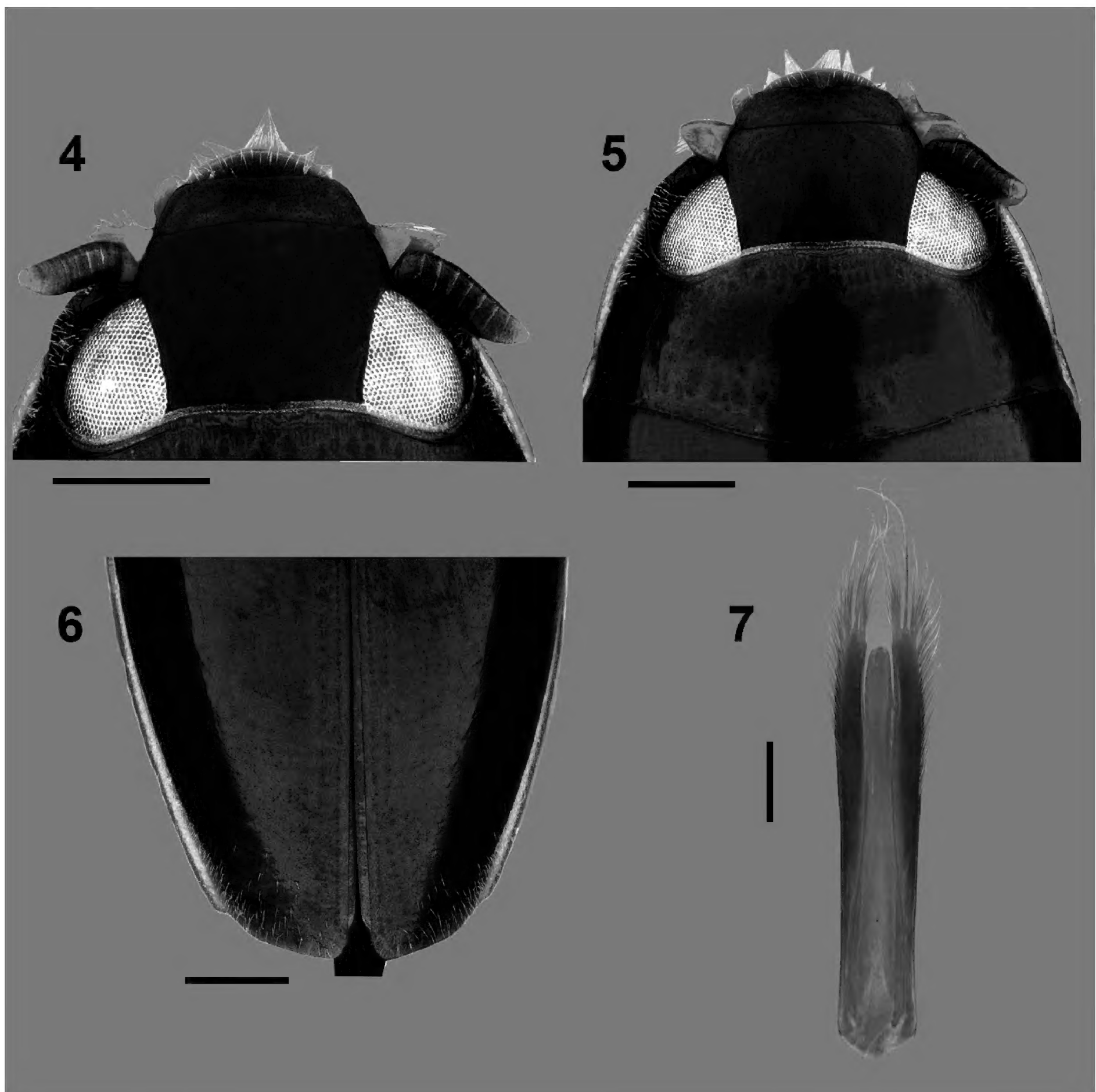
Diagnosis. *Adult male*: dorsal surface dark brown, shiny, light brown crease on pronotum and elytra (Figs 9, 10); ventral surface dark brown, legs reddish brown (Fig. 11); dorsal eyes triangular (Fig. 12); labrum with light brown setae on apical edge (Fig. 12); pronotal pubescent border narrowed, wider at the base with 7 or 8 rows of setae (Fig. 9); elytra with fine punctures, pubescent border narrow at the base, extending medially toward the apex; elytral apex strongly pubescent with dense setae (Figs 10, 14); elytral apex with both outer and inner angles rounded (Fig. 14); protarsus $1.7 \times$ longer than wide (Fig. 10). *Aedeagus*: parameres slender, with apex rounded and with a row of short setae on each latero-apical edge, starting on apical $1/3$; median lobe with apex lanceolate (Fig. 15).

Geographical distribution (Fig. 16). BRAZIL (Maranhão*, Mato Grosso).

Material examined. BRAZIL • 5 ♂; Maranhão/Cax-



Figures 1–3. Habitus of *Gyretes minax* Ochs. **1.** Lateral view. **2.** Dorsal view. **3.** Ventral view. Scale bars = 1 mm.



Figures 4–7. *Gyretes minax* Ochs. **4.** Head, dorsal view. **5.** Head and pronotum, dorsal view. **6.** Elytra, dorsal view. **7.** Aedeagus, dorsal view. Scale bars = 0.2 mm.

ias/APA Inhamum/Igarapé Soledade; 04°53'40.8"S, 043°25'18.9"W; 384 m a.s.l.; 20–21 Dec. 2014; G.R. Desidério & S.R.S. Nascimento leg.; water surface; CZMA.

Discussion

Twelve Gyrinidae species were previously known from northeastern Brazil. To date, only four species and three subspecies belonging to the genus *Gyretes* are recorded from Bahia state—*G. agilis* Ochs, 1965, *G. levis inops* Ochs, 1960, and *G. scaphidiformis bahiensis* Ochs, 1954—and Pernambuco state—*G. celox* Ochs, 1965 and *G. levis schubartianus* Ochs, 1960 (Colpani et al. 2014). The new records of *G. minax* and *G. puberulus* for Maranhão state increase from four to six the number of species known for Brazil's Northeast Region.

Gyretes minax was originally described based on

male and female adults, including information on the aedeagus, but Ochs (1967) gave no illustration for the characters used on description. Recently, the eggs of this species were associated with adults, and their morphology was described and illustrated (Colpani et al. 2018). On the other hand, *G. puberulus* was described based on male and female adults, but then again without illustrations of both (Ochs 1967). In contrast to *G. minax*, the characters of the aedeagus were not provided for *G. puberulus* in its original description, and its immature stages are so far unknown. Thus, based on the analysis of the type specimens, we provide a diagnosis for each species, including characteristics of the body and aedeagus and illustrations of the main features.

Gyretes minax was previously known only from the Amazon biome, where it is very abundant in the Central Amazon (Benetti and Hamada 2003; Colpani et al. 2014).

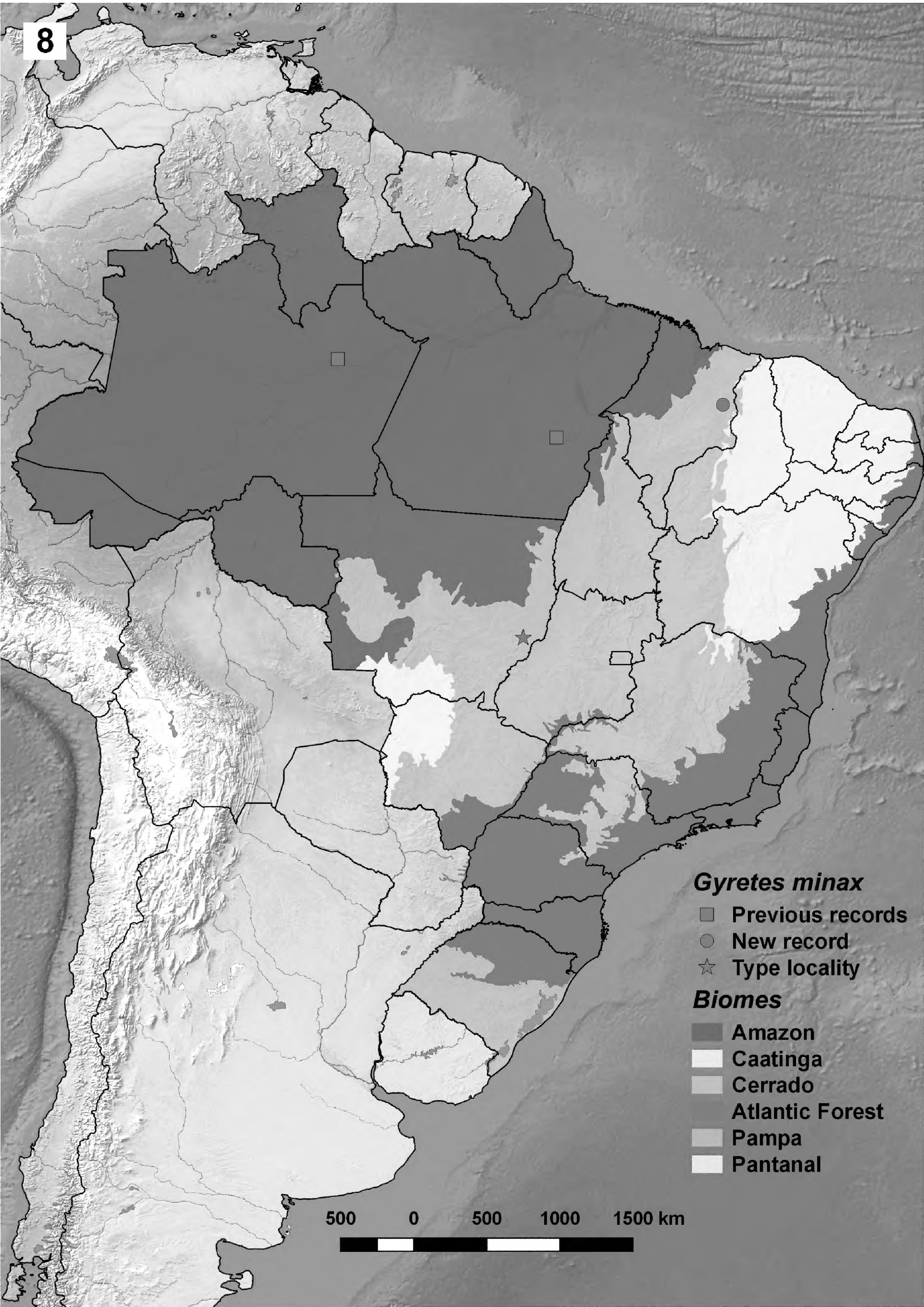
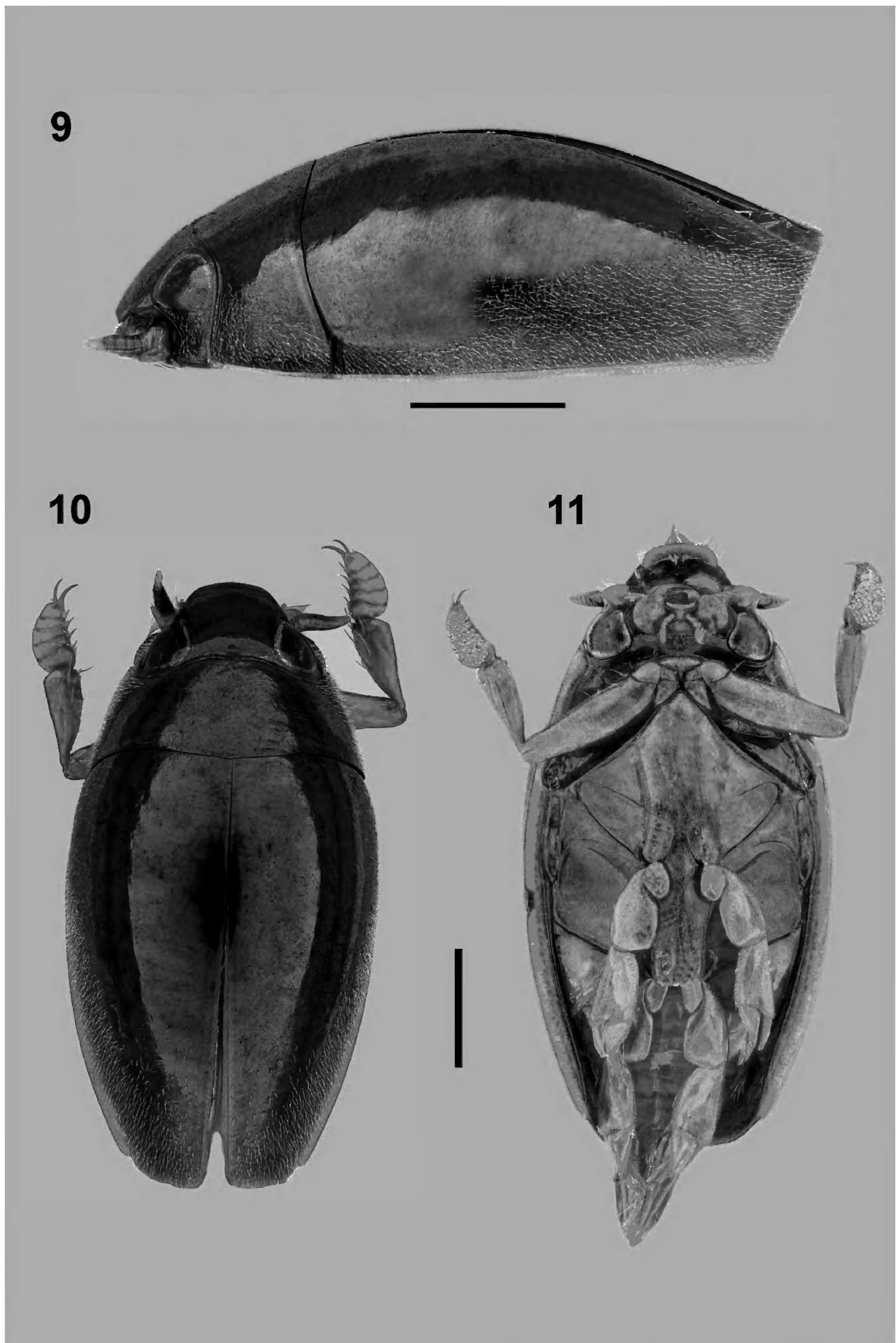
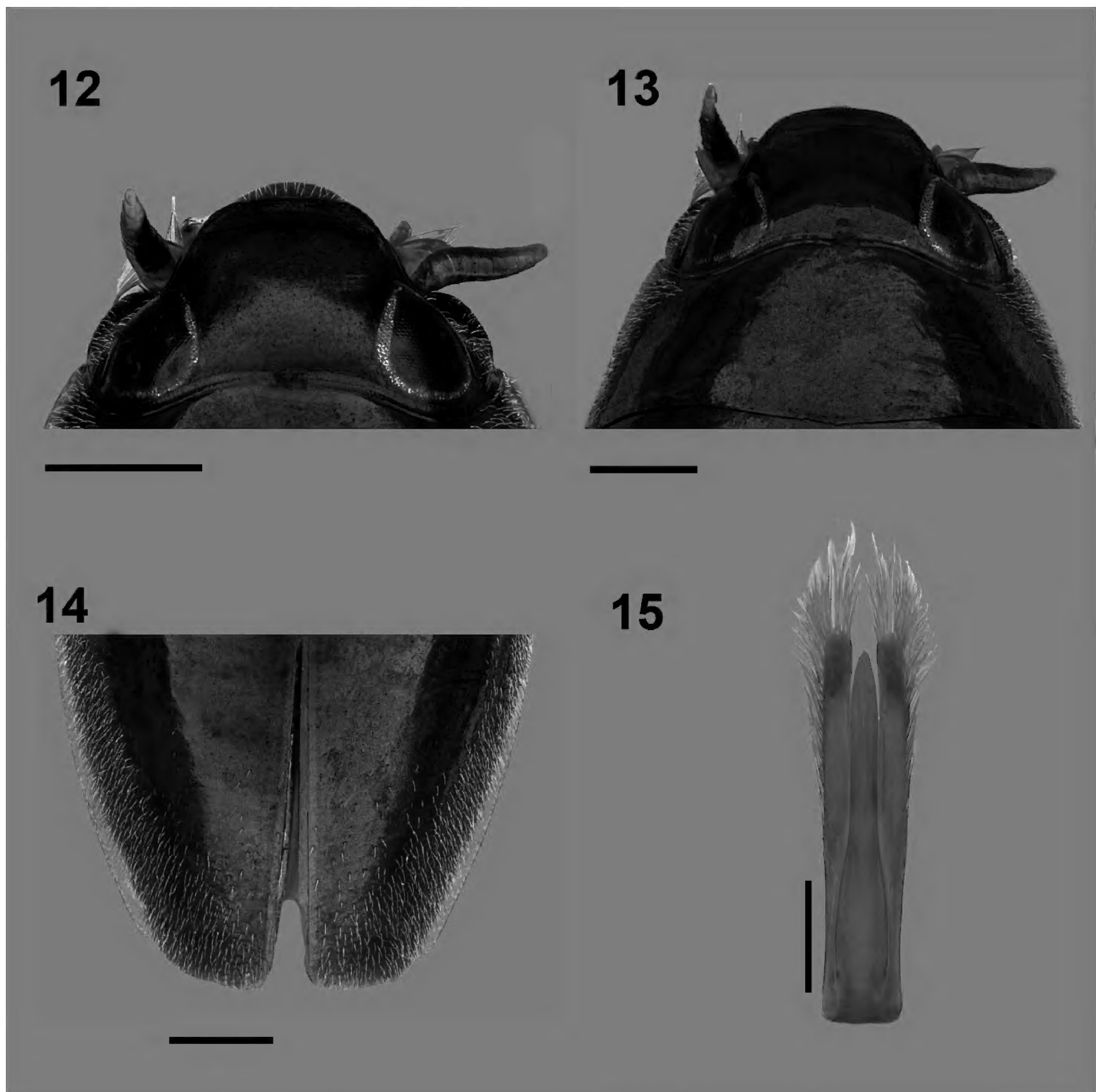


Figure 8. Geographical distribution of *Gyretes minax* Ochs.



Figures 9–11. Habitus of *Gyretes puberulus* Ochs. **9.** Lateral view. **10.** Dorsal view. **11.** Ventral view. Scale bars = 1 mm.



Figures 12–15. *Gyretes puberulus* Ochs. **12.** Head, dorsal view. **13.** Head and pronotum, dorsal view. **14.** Elytra, dorsal view. **15.** Aedeagus, dorsal view. Scale bars = 0.2 mm.

However, the type locality of this species is located in the Cerrado–Amazonian forest transition zone in Mato Grosso state (Nova Xavantina municipality; Ochs 1967). The distribution of *G. puberulus* was only known from the type locality, as was *G. minax* in Mato Grosso state (Ochs 1967; Colpani et al. 2014). Here the distributions of these species are extended in the Cerrado biome, with the northernmost records now in Maranhão state.

The foregoing information and illustration of the morphology of *G. minax* and *G. puberulus* may help in correct identification by non-specialists and the use of these species for biomonitoring of aquatic environments. Although our study improves knowledge of whirligig beetles, it does not represent the true diversity of Gyrinidae in northeastern Brazil, given the lack of studies of this group in states neighboring Maranhão.

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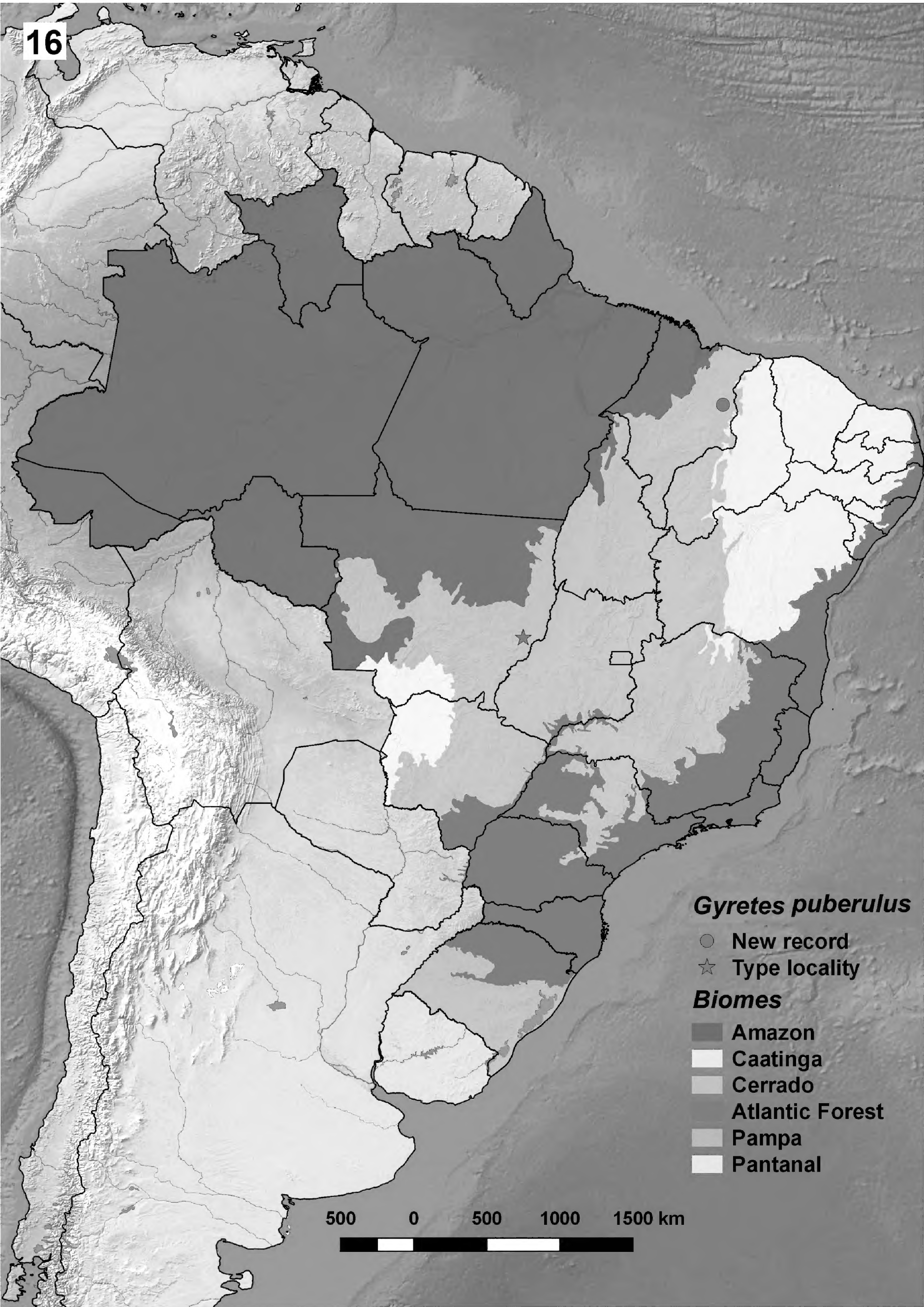


Figure 16. Geographical distribution of *Gyretes puberulus* Ochs.

collecting permits (process no. 15078-1). We highly appreciate the valuable comments and corrections of Dr Miguel Archangelsky and thank Philip M. Fearnside for revising the manuscript.

Authors Contributions

GRD and SRSN collected the specimens; DC identified the specimens; DC and GRD produced the photographs and maps and edited the manuscript; all authors contributed to writing the manuscript.

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